

Supplementary Materials: Correlation between Defect Density and Corrosion Parameter of Electrochemically Oxidized Aluminum

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Schematic Diagram of Anodizing/PEO Setup and Working Procedure

Anodization and PEO treatment of aluminum alloy 6061 samples have been carried out in the setup of Figure S1. The entire experimental procedure is illustrated in the procedure diagram of Figure S2.

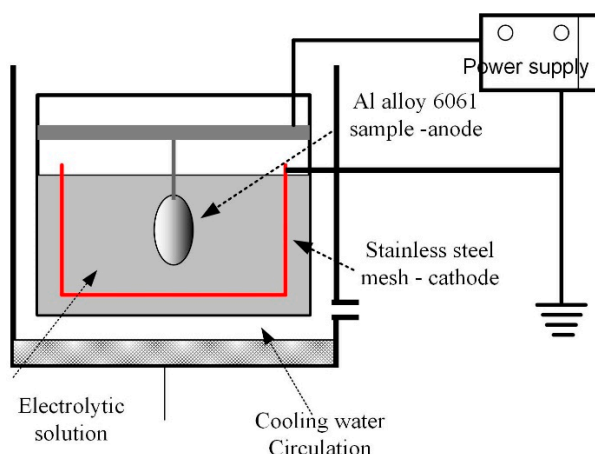


Figure S1. Schematic diagram of setup for anodizing the 6061 sample, following by PEO treatment.

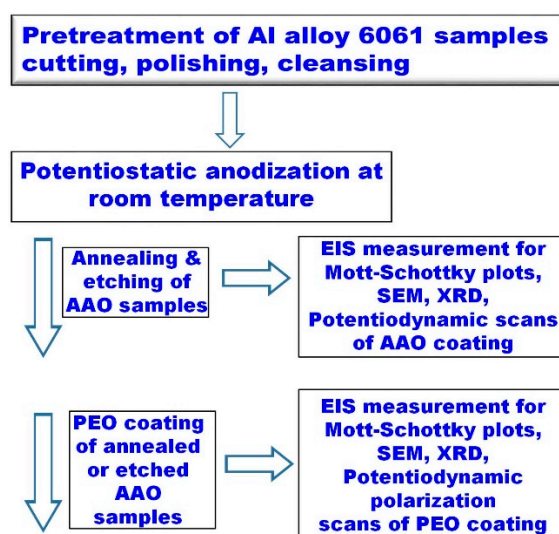


Figure S2. Experimental procedure of electrochemical oxidation, characterization, and corrosion analysis.

Correlation between Corrosion Parameters and Acceptor Density

The correlations between corrosion parameters (J_{corr} , R_p , E_{corr}) and acceptor density (N_a) are also attempted. Figure S3(a) shows that percent deviation from the linear correlation between J_{corr} and N_a is 38%. Figure S3(b) shows percent deviation from the linear correlation between R_p and N_a is 38%. Figure S3(c) indicates percent deviation from the linear correlation between E_{corr} and N_a is 32%. These percent deviation values for J_{corr} and R_p are much higher than those deviations of correlation with donor density, which are 8.1% and 5.7%. Hence, we conclude that the acceptor-rich interface cannot be responsible for corrosion protection, and the donor-rich interface is.

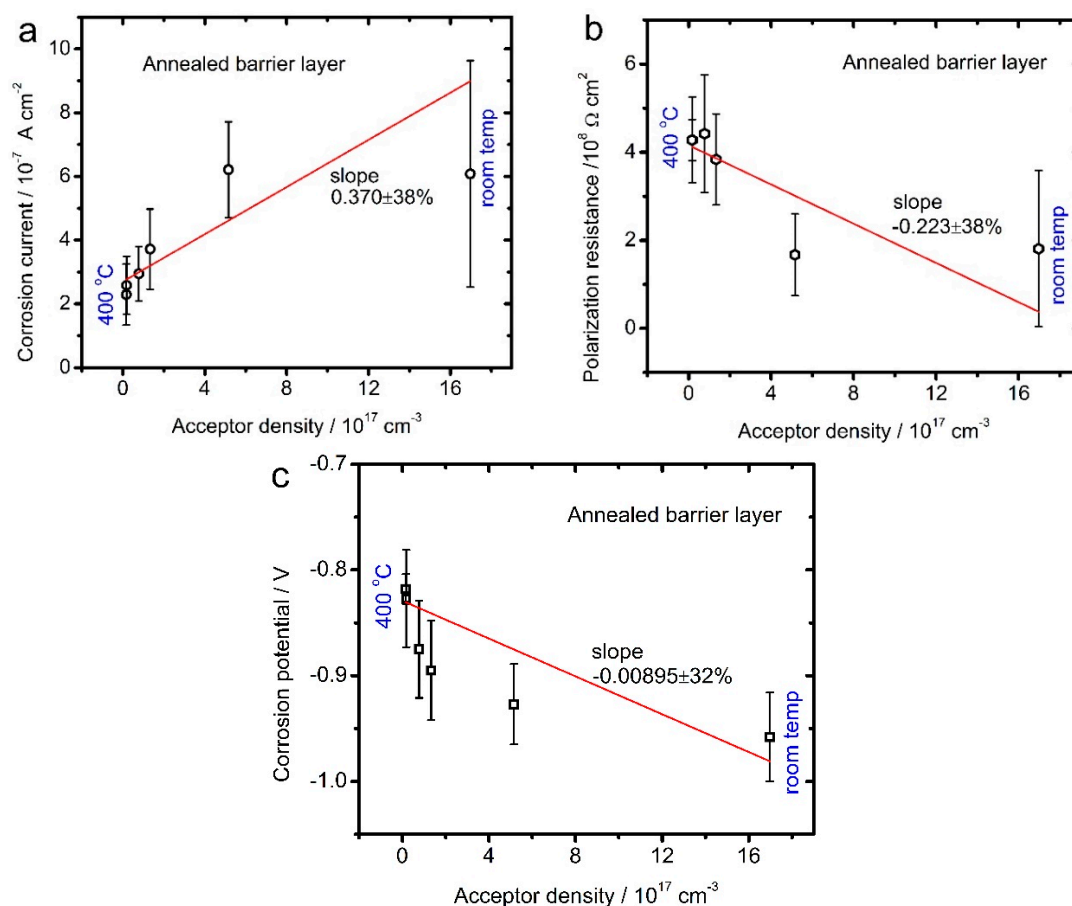


Figure S3. Linear correlation between corrosion parameters and acceptor density. In contrast to Figure 4b–d, the correlations are poor with respect to acceptor density. Correlation is attempted between (a) J_{corr} and N_a , (b) R_p and N_a , and (c) E_{corr} and N_a .

X-ray Diffraction Results

Both diffraction patterns of AAO and PEO coatings are dominated by the diffraction lines of underlying aluminum metal at 38.5° , 44.7° , 65.1° , and 78.2° (2θ). Minor diffraction peaks of γ -alumina (JCPDS-01-1303) are observed in the PEO pattern, not in the AAO pattern.

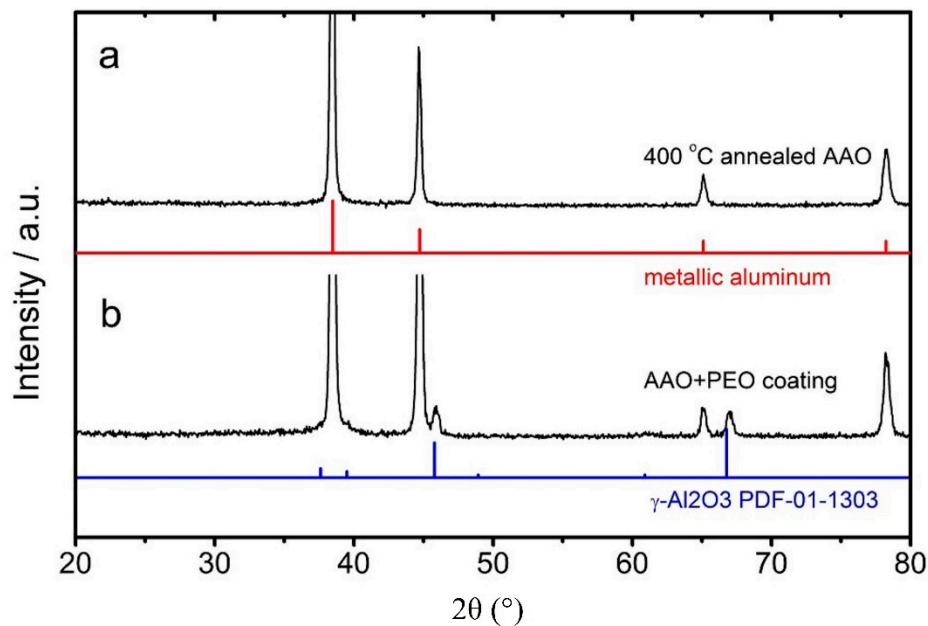


Figure S4. XRD patterns of AAO and PEO coatings. (a) The result of 400 °C annealed barrier layer displays the diffraction lines of metallic aluminum substrate only. (b) The diffraction result of PEO coating that began with an AAO precursor shows the gamma aluminum oxide features in addition to the diffraction lines of aluminum metal.

Video File of the First Appearance of Microdischarges During PEO

The attached hyperlink is a video showing the observation of the first few sparks at 10 s in PEO around the edge of the workpiece with a pre-anodized barrier layer. The first appearance of microdischarges of other samples also occur at the same PEO time. <https://drive.google.com/file/d/1k6Cx0BRljJcrAY6qNyjyn-Buw-n0a4gr/view?usp=sharing>



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